CLAIMS

I claim:

1. An object detection system comprising

a retroreflector;

a emitter-detector assembly having a light emission area from which a light beam is emitted toward the retroreflector and having a light detection area in which light impinging thereon from the retroreflector produces an electrical signal, wherein the light emission area and the light detection area are concentric with one extending around the other.

2. The object detection system as recited in claim 1 wherein the light emission area extends around the light detection area.

3. The object detection system as recited in claim 2 wherein the light detection area comprises a photodetector and the light emission area comprises a plurality of light emitters located at different angles axially around the photodetector.

4. The object detection system as recited in claim 1 wherein the light detection area extends around the light emission area.

5. The object detection system as recited in claim 4 wherein the light emission area comprises a light emitter, and the light detection area comprises a plurality of photodetectors located at different angles axially around the light emitter.

6. The object detection system as recited in claim 1 wherein the light detection area is substantially equal in size to the light emission area.

7. The object detection system as recited in claim 1 wherein the emitter-detector assembly further comprises a housing having an inner chamber in which one of the light detection area and the light emission area is located, and an annular outer chamber in which the other one of the light detection area and the light emission area is located.

8. The object detection system as recited in claim 1 having a quality factor Q that is greater than 0.25, where the quality factor is given by the expression:

$$Q = (Rs\ Srf) / (Rd\ Srr\ Gmax)$$

in which Rs is a signal produced by the emitter-detector assembly in response to returned light from a retroreflector, Srf is the size of the field of view in steradians of the light detection area, and Srr is the size in steradians of the light beam that is subtended by the retroreflector, Rd is the signal produced by the emitter-detector assembly in response to returned light from a 100% uniformly diffuse surface, and Gmax is a maximum reflectance of the retroreflector compared to light returned from a 100% uniformly diffuse surface.

9. The object detection system as recited in claim 1 having a quality factor Q that is greater than 0.25, where the quality factor is given by the expression:

$$Q = \iint Gr(x)\, dS\, dD] / (As\, Ad)$$

where As is the size of the light emission area, Ad is the size of the light detection area, dS is an area element of the light emitting aperture, dD is an area element of the photodetector aperture, x is the separation between the source aperture and detector aperture area elements, and Gr(x) is the relative gain of the retroreflector at the displacement x between source and detector area elements compared to the maximum attainable return.

10. The object detection system as recited in claim 1 wherein the light emission area comprises at least one light emitter selected from the group consisting of a light emitting diode, a laser, an incandescent bulb, a fluorescent bulb, a phosphorescent emitter, and an electroluminescent emitter.

11. The object detection system as recited in claim 1 wherein the light detection area comprises at least one device selected from the group consisting of a photodiode, a phototransistor, a thermopile, a solid state imager, a photomultiplier tube, and a pyroelectric detector.

12. An emitter-detector assembly for object detection system having a retroreflector, the emitter-detector assembly comprising:

a light emission section comprising at least one emitter from which a light beam emanates in a first path; and

a light detection section which produces an electrical signal in response to light impinging thereon from the retroreflector, wherein the light emission section is concentric with the light detection section.

13. The emitter-detector assembly as recited in claim 12 wherein the light detection section comprises a photodetector and the light emission section comprises a plurality of light emitters located at different angles axially around the photodetector.

14. The emitter-detector assembly as recited in claim 12 wherein the light detection section comprises a photodetector and the light emission section comprises a light emitter assembly extending around the photodetector.

15. The emitter-detector assembly as recited in claim 12 wherein the light emission section comprises at least one light emitter selected from the group consisting of a light emitting diode, a laser, an incandescent bulb, a fluorescent bulb, a phosphorescent emitter, and an electroluminescent emitter.

16. The emitter-detector assembly as recited in claim 12 wherein the light detection section comprises at least one device selected from the group consisting of a photodiode, a phototransistor, a thermopile, a solid state imager, a photomultiplier tube, and a pyroelectric detector.

17. The emitter-detector assembly as recited in claim 12 wherein the light detection section is substantially equal in cross-sectional area to the light emission section.

18. The emitter-detector assembly as recited in claim 12 having a quality factor Q that is greater than 0.25, where the quality factor is given by the expression:

$$Q = \iint Gr(x)\, dS\, dD] / (As\, Ad)$$

where As is the size of the light emission area, Ad is the size of the light detection area, dS is an area element of the light emitting aperture, dD is an area element of the photodetector aperture, x is the separation between the source aperture and detector aperture area elements, and Gr(x) is the relative gain of the retroreflector at the displacement x between source and detector area elements compared to the maximum attainable return.

19. The emitter-detector assembly as recited in claim 12 further comprising a housing having an inner chamber in which one of the light detection section and the light emission section is located, and an annular outer chamber extending around the inner chamber and in which the other one of the light detection section and the light emission section is located.